Name _____ Honors Chemistry ___/___/___

Bond & Molecular Polarity

You were taught earlier this chapter that covalent compounds share electrons. Sometimes**, both atoms have the same (or a small difference in) pull or attraction for the shared electrons**. When this happens a **non-polar bond** is formed. It is called non-polar because there is **no pull of the electrons to any one atom, or pole**. Although non-polar bonds mostly occur when electrons are shared between atoms of the same element, they can occur between atoms of different elements when the **electronegativity difference is less than 0.4**.

The other type of covalent bond is a **polar covalent bond**. Polar covalent bonds occur when the **electrons that are shared between two atoms are pulled towards one end or pole**. In a polar covalent bond the **electronegativity difference between the two atoms sharing the electrons is between 0.5 and 1.6.** When the electronegativity difference between elements is **greater than 2.0**, the bond is **ionic**. You were taught earlier this year that in an ionic bond electrons are gained and lost, not shared. This presents a problem; what about the gap between 1.6 and 2.0? If the electronegativity difference is between 1.6 and 2.0 and the compound contains only non-metals the bond is polar covalent. If the electronegativity difference is between 1.6 and 2.0 and the compound contains a metal the bond is ionic.

We are focusing on covalent compounds this chapter so for now the following rules apply:

Electronegativity Difference	Type of Bond
0.0 - 0.4	Non-Polar Covalent
0.5 - 2.0	Polar Covalent

I. Determining Whether a Bond is Polar or Non-polar

1. After drawing a molecule's structural formula, write down each of the different bonds in the molecule.
2. Use your periodic table to determine the electronegativity of each element in the bond.
3. Calculate the difference between the two electronegativity values.
4. Using the chart to the right, determine if the bond is polar covalent, non-polar covalent, or ionic.

The numbers in the chart are only a reference. A bond does not automatically change from being non-polar to polar when the electronegativity value becomes greater than 0.4. Instead, polarity is a gradual change that increases as the electronegativity difference increases.

II. Determining Whether a Molecule is Polar or Non-Polar

Answer the following questions:

Question 1: Is there AT LEAST one polar bond?

If No – The molecule is **Non-Polar**.

If Yes → (Go to question 2)

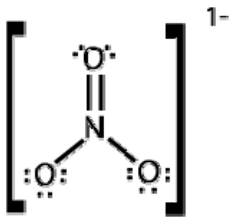
Question 2: Is the molecule symmetrical?

If Yes – The Molecule is **Non-Polar**

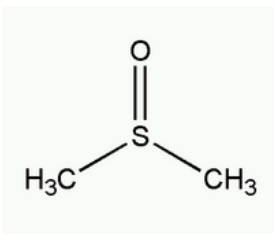
If No – The Molecule is **Polar**.

Note: Symmetry only exists when the same atom is at all available bonding sites. A molecule is NOT symmetrical if there are unshared electrons on the central atom UNLESS the shape of the molecules is linear or square planar.

For example: Nitrate is symmetrical.



Dimethyl sulfoxide is NOT symmetrical.



Homework: Complete the following information. For the labeled structural formula you can eliminate unshared electrons on the outer atoms. Include them on the central atoms.

Formula	Bond Polarity	Labeled Structural Formula	Molecular Polarity
SF_4			
BrF_5			
NH_3			
XeF_2			
CH_4			
CO			
SO_4^{2-}			
SF_6			
SO_2			
CO_2			

Formula	Bond Polarity	Labeled Structural Formula	Molecular Polarity
CCl_2F_2			
NO_3^{1-}			
CO_3^{2-}			
CCl_4			
XeF_4			
AsF_3			
CH_2O			
ClF_3			
PF_5			
$BeCl_2$			

Group →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
↓ Period																		
1	H 2.20																	He
2	Li 0.98	Be 1.57											B 2.04	C 2.55	N 3.04	O 3.44	F 3.98	Ne
3	Na 0.93	Mg 1.31											Al 1.61	Si 1.90	P 2.19	S 2.58	Cl 3.16	Ar
4	K 0.82	Ca 1.00	Sc 1.36	Ti 1.54	V 1.63	Cr 1.66	Mn 1.55	Fe 1.83	Co 1.88	Ni 1.91	Cu 1.90	Zn 1.65	Ga 1.81	Ge 2.01	As 2.18	Se 2.55	Br 2.96	Kr 3.00
5	Rb 0.82	Sr 0.95	Y 1.22	Zr 1.33	Nb 1.6	Mo 2.16	Tc 1.9	Ru 2.2	Rh 2.28	Pd 2.20	Ag 1.93	Cd 1.69	In 1.78	Sn 1.96	Sb 2.05	Te 2.1	I 2.66	Xe 2.60
6	Cs 0.79	Ba 0.89	*	Hf 1.3	Ta 1.5	W 2.36	Re 1.9	Os 2.2	Ir 2.20	Pt 2.28	Au 2.54	Hg 2.00	Tl 1.62	Pb 2.33	Bi 2.02	Po 2.0	At 2.2	Rn 2.2
7	Fr 0.7	Ra 0.9	**	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Uut	Fl	Uup	Lv	Uus	Uuo

* Lanthanoids	La 1.1	Ce 1.12	Pr 1.13	Nd 1.14	Pm 1.13	Sm 1.17	Eu 1.2	Gd 1.2	Tb 1.1	Dy 1.22	Ho 1.23	Er 1.24	Tm 1.25	Yb 1.1	Lu 1.27
** Actinoids	Ac 1.1	Th 1.3	Pa 1.5	U 1.38	Np 1.36	Pu 1.28	Am 1.13	Cm 1.28	Bk 1.3	Cf 1.3	Es 1.3	Fm 1.3	Md 1.3	No 1.3	Lr 1.3